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University Students' Epistemic Beliefs, Academic Disciplines, and Academic Achievement

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Tiivistelmä - Referat - Abstract

Episteemiset uskomukset ovat jokseenkin pysyviä käsityksiä siitä, mitä tieto on. Niiden on yhtäältä todettu kehittyvän yliopisto-opintojen aikana ja toisaalta koostuvan useista, toisiinsa kietoutuneista ulottuvuuksista. Tämän tutkimuksen tarkoituksena oli tutkia yliopisto-opiskelijoiden episteemisiä uskomuksia ja niiden mahdollisia yhteyksiä tieteenaloihin sekä opinnoissa menestymiseen. Aiempien tutkimusten perusteella episteemisten uskomusten ulottuvuudet painottuvat jokseenkin eri tavoin eri tieteenaloilla, huolimatta siitä, että relativistisempia episteemisiä ulottuvuuksista pidetään yleisesti toisia sofistikoituneempina. Relativistisemmilla episteemisillä uskomuksilla on myös aiemmin todettu olevan positiivinen yhteys opintomenestyksen kanssa. Tässä tutkimuksessa episteemisiä uskomuksia tutkitaan henkilöorientoituneella lähestymistavalla, sillä opiskelijoiden episteemisten profiilien kautta voimme ymmärtää paremmin tieteenalan keskimääräisen opiskelijan episteemisiä lähtökohtia.

Tutkimuksen kohteena oli 831 Helsingin yliopiston ensimmäisen vuoden opiskelijaa vuosilta 2013 ja 2014. Tutkimuksen aineisto on osa Mind the Gap –tutkimushanketta ja se on kerätty pääosin suurilta johdantokursseilta useita osa-alueita sisältäneellä kyselylomakkeella. Lisäksi tutkimuksessa hyödynnettiin opiskelijarekisteristä saatuja tietoja opiskelijoiden opintojen etenemisestä ja opintomenestyksestä. Aineistoa analysoitiin SPSS-ohjelmalla tilastollisin menetelmin hyödyntäen TwoStep-klusterianalyysiä, ristiintaulukointia sekä monimuuttujaista kovarianssianalyysiä MANCOVAa.

Opiskelijat voitiin jakaa episteemisten uskomusten pohjalta kolmeen erilaiseen episteemiseen profiiliin: ei-reflektiiviset, reflektiiviset teoristit ja käytännölliset akateemiset. Profiilien sijoittumisessa eri tiedekuntiin löytyi tilastollisesti merkitseviä, aiempien tutkimusten kanssa linjassa olevia eroja. Reflektiivisiä teoristeja löytyi eniten valtiotieteellisestä tiedekunnasta ja vähiten lääketieteellisestä. Käytännöllisten akateemikkojen osuus oli huomattavan suuri käyttäytymistieteellisessä tiedekunnassa ja ei-reflektiivisten oikeustieteellisessä. Reflektiiviset teoristit menestyivät opinnoissa muita profiileita paremmin, mutta opintojen etenemisen suhteen merkitseviä eroja ei löytynyt. Tämä tutkimus osaltaan lisäsi kokonaisvaltaista ymmärrystä epistemologioista yliopistokontekstissa, ja sitä voidaan hyödyntää esimerkiksi yliopisto-opintojen ja opiskelijavalinnan suunnittelussa paikallisesti.

Avainsanat - Nyckelord	Episteemiset uskomukset, tieteenalat, yliopisto-opiskelijat, opintomenestys
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Tiivistelmä - Referat - Abstract

Epistemic beliefs are somewhat stable conceptions of what knowledge is. On one hand, they have been suggested to be a developmental sequence, and on the other hand, consist of multiple intertwined dimensions. The aim of this study is to research the connections in university students' epistemic beliefs, and their relation to academic disciplines and academic achievement. Previous studies have suggested that while some disciplinary differences exist, the more relativistic epistemic beliefs have generally been seen as more sophisticated ones. These more relativistic epistemic beliefs have previously been shown to be positively connected to better academic achievement. A person-oriented approach is applied in this study, to provide a tangible perspective to the students' epistemic beliefs.

The sample consisted of 831 first-year students from University of Helsinki from years 2013 and 2014. The data used in the study was part of Mind the Gap –project, and it was collected with a multi-sectioned questionnaire, mainly from large introductory courses. Additional data from the study register was used to examine academic achievement. The data was analyzed statistically with SPSS, using TwoStep cluster analysis, crosstabs, and Multivariate Analysis of Covariance (MANCOVA).

Three epistemic profiles were found: Non-Reflective Students, Reflective Theorists, and Practical Academics. Some significant differences, supported by earlier research, were found in the representation of the identified epistemic profiles in the faculties. Reflective Theorists were broadly represented in the Faculty of Social Sciences and sparse in the Faculty of Medicine. Additionally, Practical Academics were largely present in the Faculty of Behavioral Sciences, and Non-Reflective Students in the Faculty of Law. In regards to Study Performance, Reflective Theorists had significantly higher Study Performance (GPA) than the two other profiles. This study overall broadened the comprehensive understanding of university students' epistemic beliefs, and can be useful in planning university studies and student intake locally.

Avainsanat - Nyckelord

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1 Introduction

Universally, the aim of formal education is to set students up for success, and universities are no different in that regard. Professors, lecturers, and instructors work hard to plan and execute practices like curriculums and teaching to support students' professional and personal growth.

Epistemic beliefs, an individual's ways of defining what knowing is and how one comes to know (Hofer & Pintrich, 1997; Hofer, 2001), can be useful in framing appropriate practices in supporting the students, as through them we can better understand how individuals make meaning (Hofer, 2000). These beliefs have been shown to develop during studies in higher education (Perry, 1970; King & Kitchener, 1994) and a multitude of factors including years in formal education (Schommer, 1998), disciplinary domains (Hofer, 2000; Jehng, Johnson, & Anderson, 1993), and previous educational experiences (King & Kitchener, 2004; Entwistle & Peterson, 2004) have been found to be linked on how one views what knowledge is. Further research on epistemic beliefs can help us understand how one's views of knowledge are linked to learning (Schommer, 1990; 1993), as facilitating the development towards more complex epistemic beliefs is not as simple as learning individual skill (Baxter Magolda, 2006). Being aware of these developing, but fairly stable, mental constructions can be a useful tool for educators and universities at large in planning curriculums and practices that support students' success.

The present study approaches epistemic beliefs from a person-oriented view by studying epistemic profiles found in university students. These study profiles are further researched in relation to fields of study (academic disciplines) and academic performance. It has been shown that epistemic beliefs are linked to both fields of study (Hofer, 2000; Jehng, Johnson & Anderson, 1993) and academic performance (Hofer & Pintrich, 1997; Schommer, 1990; 1993; Heikkilä, Lonka, Nieminen, & Niemivirta, 2012), and this study furthers this area of research by examining both factors together. Moreover, using a combination of variable-oriented and person-oriented approaches can allow one to see the

researched phenomena from interesting perspectives (Bergman, Magnusson, & El-Khouri, 2003).

The aim of this study is to further research the connections between epistemic profiles, academic disciplines, and academic achievement in the first years of university studies. As we learn more about epistemic beliefs and how they are related to learning outcomes we can utilize the knowledge to better instruct and educate university students. It has been argued that educators can't support students in becoming reflective thinkers and skilled problem solvers without acknowledging the epistemic beliefs that the students hold (King & Kitchener, 1994). This study aims to not only further the knowledge on university students' epistemic beliefs, but to provide practical insight for university educators and policy-makers to support students' overall success.

2 Epistemic beliefs

Epistemic beliefs, also referred to as conceptions of knowledge and learning, can be defined as an individual's way of viewing what knowledge and knowing are, and how one comes to know (Hofer & Pintrich, 1997; Hofer, 2001). The word epistemic as such refers to epistemology, an area of philosophy interested in the nature and justification of knowledge (Hofer & Pintrich, 1997). Over the years of research on these developmental processes of how an individual conceptualizes what knowledge is and how it is acquired, various terminologies have been used. In this study, the term *epistemic beliefs* is used to describe this multidimensional developmental phenomenon, including perspectives of both knowledge and learning. Epistemic beliefs has recently become the most popularly used term, but terms such as personal epistemology (Hofer & Pintrich, 1997), epistemic cognition (Hofer, 2016), epistemological beliefs (Schommer, 1990; 1994; Heiskanen & Lonka, 2012), reflective judgement (King & Kichener, 1994), and concepts of knowledge and learning (Entwistle & Peterson, 2004; Marton & Säljö; 1976) have also been used to describe these processes. In this chapter I introduce some of the main studies done in the research on epistemic beliefs, framing the context of this present study in the existing field. I also accentuate the epistemic beliefs used in this study and its context specifically.

2.1 What are epistemic beliefs?

Research on the phenomenon of epistemic development dates back to the 1960s, however, epistemic beliefs per se, are still a growing area of interest among researchers in the fields of psychology and education (Hofer, 2016). The framework for epistemic studies in general has its origin in Piaget's studies on genetic epistemology and theories of cognitive development in the 1950s (Hofer & Pintrich, 1997). Though, it can be said that the pioneer of psychological research on personal epistemic beliefs and epistemic beliefs is William G. Perry (Hofer, 2016). Perry (1970) conducted two longitudinal studies on how male university students in 1960s made meaning of their academic experiences (Hofer, 2000), and accordingly defined epistemic beliefs as an individual's

definition of knowledge, how it is acquired, its certainty, and what are its limitations and criteria (Perry, 1970). By conducting his studies, Perry was the first to suggest that epistemic beliefs are not part of an individual's personality but a developmental process. (Hofer & Pintrich, 1997).

Perry's (1970) work, *Forms of Intellectual and Ethical Development in College Years,* is thought to have substantial impact in the direction of the developmental literature on epistemic beliefs (Baxter Magolda, 2006). Most of the studies and models on epistemic beliefs focus on the means and justifications of knowing and knowledge. It has been discussed, whether dimensions of learning should be included in the models on epistemic beliefs or not. Many (Perry, 1970; King & Kitchener, 1994; Hofer & Pintrich, 1997) argue that epistemic development should only be concerned with the essence of knowledge and knowing themselves. In turn, more recent multidimensional models (Heiskanen & Lonka, 2012; Schommer, 1990;1993) have also included some aspects of learning due to the close relationship of beliefs on knowledge and beliefs on how knowledge is acquired. In the following chapters I will outline three predominant approaches that can be found in the previous studies on epistemic beliefs.

First, the scheme Perry (1970) developed consisted of nine developmental positions starting from positions basing on simple dualism, and developing towards integrative commitment in relativism. The positions were thought to be mutually inclusive in that a student holding more relativistic beliefs can also hold the ones of previous position simultaneously (Perry, 1970). Despite Perry's (1970) role as a pioneer of the field his work quickly received criticism, for example, on the sample consisting of only male students (Hofer & Pintrich, 1997; Baxter Magolda, 2006). Belenky, Clinchy, Goldberger, and Tarule (1986) extended Perry's (1970) work by examining how women view knowledge and the justifications of it. Belenky et al. (1986) introduced a hierarchical model consisting of five stages of development (from silence to constructed knowledge) that was analogous, yet more socially comprehensive, to Perry's (1970) positions. Baxter Magolda's (1992) model of epistemic reflection demonstrated four ways of knowing, developing from absolute knowing to contextual knowing. This study (Baxter Magolda, 1992) was unique in including both men and women in it, but

lacked in diversity otherwise, focusing mainly on white, upper-class university students. Existing literature suggests (see Hofer & Pintrich, 1997; Hofer, 2001; Baxter Magolda, 2006) these three focal studies create the groundwork for the constructivist-developmental approach in epistemic beliefs, and form a research paradigm of hierarchical development models that are regarded in relation to formal higher education. In other words, the above models view epistemic beliefs as a developmental sequence, in which the next stage can't be reached without holding the beliefs of the previous one.

Another, and perhaps complementary to the ones above, approach for learning about epistemic beliefs emphasizes the meaning of existing epistemic assumptions, specifically the role of reasoning and justification of knowledge in epistemic beliefs (see Hofer, 2000; Hofer & Pintrich, 1997). King & Kitchener (1994) conducted a 20-year-long longitudinal study on epistemic beliefs, basing their approach on epistemic assumptions and justifications of knowledge. The Reflective Judgement Model (RJM) was created as the result of this extensive study, describing the development of epistemic beliefs from childhood to adulthood. The model presents seven stages of development, ending with the ability to make reflective judgements on varied and complex issues (King & Kitchener, 1994), with the main interest on epistemic awareness in the developmental process. Reflective judgement is also a developmental model, though the development of epistemic beliefs in RJM is not presented as tied to formal education as it is in the other models presented (see above), distinguishing it from them. Additionally, though Kuhn's (1991) main interest was in skills of argumentation, the study she conducted added to the research of epistemic beliefs and processes of knowing in relation to reasoning and justifications of knowledge, and appreciation of the evaluation of knowledge.

Recently, a popular approach to research in epistemic beliefs describes them as a multidimensional system of beliefs rather than a sequence of developmental stages. Schommer (1990; 1993) suggested that the epistemic beliefs are somewhat independent orthogonal dimensions that have an effect on students' learning. Further, Hofer (2000) suggested a four-dimensional model consisting of certainty of knowledge, simplicity of knowledge, justification for knowing, and

source of knowledge. No unanimous view has been found for what the exact dimensions should be, and discussion on whether characteristics of learning should be included in research on epistemic beliefs or not is constantly had (see Hofer & Pintrich, 1997; Hofer, 2001; Schommer-Aikins, 2002). Although the dimensions presented by Schommer (1990;1993) and Hofer (2000) have received some criticism, the multidimensional approach has been of interest for many (Heiskanen & Lonka, 2012; Lonka & Lindblom-Ylänne, 1996; Heikkilä et al., 2012; Madjar, 2017), as it seems to better capture the complexity of epistemic beliefs compared to the developmental model (Schommer-Aikins, 2002). Most recent studies have been especially interested in how learning is affected by the, likely recipropal, relationships of epistemic beliefs and other factors including, for example, study orientations (Entwistle & Peterson, 2004), study engagement (Heiskanen & Lonka, 2012), and well-being (Heikkilä et al., 2012).

Although the previous research on epistemic beliefs can be presented as categories of differing interests and approaches, there seems to be a somewhat cohesive understanding of epistemic beliefs as complex, slowly developing parts of individuals' developmental processes. Meanwhile, though epistemic beliefs have an element of change through their development, their associations with personality is thought to make them relatively consistent part of an individual (Entwistle & Peterson, 2004). Additionally, the epistemic beliefs that view knowledge as uncertain and reflective by nature, and value constructive and relativistic ways of acquiring knowledge have been thought to be the more advanced ones of epistemic beliefs (see Heiskanen & Lonka, 2012; Perry, 1979; King & Kitchener, 1994; Schommer, 1990), and many (see Hofer, 2001; Schommer, 1990;1993; Heiskanen & Lonka, 2012; Kuhn, 1991; King & Kitchener, 1994; Baxter Magolda; 1996) agree with the future goals and possible implications that educators' improved awareness of epistemic beliefs could offer in the setting of formal education. It has also been suggested (see Perry, 1970; King & Kitchener, 1994) that individuals holding epistemic beliefs of higher stage (King & Kitchener, 1994) or position (Perry, 1979) are also able to utilize the tools and approaches of the earlier stages or positions, thus the sophistication of the epistemic belief may also be about understanding the situational nature of epistemic beliefs. Accordingly, if epistemic beliefs are not seen merely as a

developmental sequence, but as somewhat independent, yet intertwined dimensions, studying them in relation to disciplines and academic achievement provides intriguing possibilities for insights regarding the development of academic education.

2.2 Epistemic beliefs and university students

Many researchers (Perry, 1979; Belenky et al. 1986; Baxter Magolda, 1992; Heiskanen & Lonka, 2012; Lindblom-Ylänne & Lonka; 1996) have been interested in the epistemic beliefs specifically in the university students. It has been suggested that higher education in general is related to more sophisticated epistemic beliefs (King & Kitchener, 1981; Schommer, 1990;1998), but even in the higher education a variety of epistemic beliefs from dualistic to relativistic can be found (Perry, 1970; Baxter Magolda, 1992; Schommer, 1990;1993). Schommer (1998) also suggests that having had specific life experiences might be more connected to epistemic beliefs than the numeral age itself. Accordingly, studying in the university as a life experience itself could advance the students' epistemic beliefs, as the different approach to learning at university education compared to formal education prior to that can challenge students views on knowledge and learning (Entwistle & Peterson, 2004). University might be the first place where the students face explicitly contrary understandings of world phenomena (Perry, 1970; Schommer, 1994). This time, full of new experiences in regards to both life overall and education, makes university students an intriguing cohort to research regarding epistemic beliefs.

Overall, recent multidimensional studies on epistemic beliefs have found that more relativistic epistemic beliefs seem often to be connected to generally positive aspects of life and studying in university students. For example, university students with more relativistic epistemic beliefs have been found to be less exhausted, have more optimistic approach to the studies, and achieve higher overall grades (Heikkilä et al., 2012) than students who view knowledge as more certain. Similar results were found in a study on cognitive-motivational profiles of

teacher students, including some dimensions of epistemic beliefs, linking low emphasis on dualistic epistemic beliefs to high values of, for example, critical evaluation and deep understanding, in addition to better well-being (Heiskanen and Lonka, 2012). Additionally, university students with beliefs towards uncertainty of knowledge have showed better comprehension (Schommer, 1990).

Continuing the recent line of multidimensional work on epistemic beliefs, the dimensions of interest in this study are derived from an earlier multidimensional study (Lonka et al., 2008) on epistemic beliefs. The dimensions used in Lonka et al. (2008), can roughly be divided into two groups of epistemic beliefs: the ones generally seen as more relativistic and advanced, and the ones seen as more dualistic (see Heiskanen & Lonka, 2012).

The first of the more relativistic epistemic dimensions is *Collaborative Knowledge Building.* It is used to describe the value that students give to collaboration between the educators and the students, and the importance of working together to develop new ideas and concepts (Lonka et al., 2008). The dimension of *Reflective Learning* refers to an individuals' ways of making an effort to process newly acquired knowledge in the light of prior knowledge (Lonka et al., 2008). Valuing Reflective Learning has been shown to have a connection with high study engagement (Heiskanen & Lonka, 2012), and positive learning outcomes (Hofer, 1997).*Valuing Metacognition* focuses on the individuals' interest on learning about their own thought processes, thus students who value metacognition highly saw their own thinking as an important part of learning (Lonka et al., 2008).

The dimension of *Certain Knowledge* has been categorized as part of dualistic epistemic beliefs (Heiskanen & Lonka, 2012), thus being generally categorized as one of the more dualistic dimensions of epistemic beliefs (Hofer, 2000). The individuals valuing Certain Knowledge highly expect authorities (for example teacher or given course material) to offer them facts, and address that there should be a clear, correct answer found (Lonka et al., 2008). *Practical Value* described individuals' views on the importance of practical relevance of the topics studied (Lonka et al., 2008). Although often connected with more dualistic

epistemic beliefs and superficial ideas of learning, the dimension of Practical Value doesn't self-evidently fall into either, dualistic or relativistic, epistemic category (Heiskanen & Lonka, 2012), as it has also seen to be related to more relativistic views on learning in the context of academic professions (Ferry & Ross-Gordon, 1998; Lindblom-Ylänne & Lonka, 1996; Schön, 1983).

3 Studying in the university

The fields of science and academic disciplines have gotten separated into fields that are specifically interested in researching some part of the world with their own approach (Becher, 1994; Ylijoki, 2000). In addition to being divided into fields with their own interests, theories, and terminology, they have been shown to also differ regarding cognitive and social structures (Ylijoki, 2000). In this study, I use the term *academic disciplines* when referring to the different groups of similar academic subjects taught in the university. In this chapter I will outline some definitions and differences of different academic disciplines, and cover some of the main societal structures related to university studies in Finland.

3.1 Academic Disciplines

One of the most widely accepted models on defining the nature of different academic disciplines was created by Anthony Biglan in the 1970s (Schommer-Aikins, Duell & Barker, 2003). Interested in the subject-matter of research in different disciplinary areas (Becher, 1994), Biglan (1973a) first defined three dimensions describing the different academic disciplines: hard–soft, pure–applied, and life system–nonlife system. According to Biglan's (1973a) dimensions, the hard–soft dimension describes how clearly defined the paradigm a said academic discipline is, the second dimension pure–applied describes the discipline's general interest in the real-life applications of the researched areas, and the third dimension life system–nonlife system presents a continuum of research on living and social systems to non-living systems. The two first dimensions (hard–soft, pure–applied) were further defined into four cluster-

categories used to examine the characteristics of different academic disciplines (Biglan, 1973b; Becher, 1994). A very similar two-dimensional (concrete–abstract, reflective–active) model was found by Kolb (1981), who examined the disciplinary characteristics regarding student learning, inquiry norms, and knowledge structures. Table 1 shows a summarized presentation of the relationship with Biglan's (1973b) and Kolb's (1981) models in relation to academic disciplines as presented by Becher (1994).

Table 1. Disciplinary areas in relation to the models by Biglan (1973b) and Kolb (1981). Table adopted from Becher (1994).

Biglan	Kolb	Disciplinary areas
Hard pure	Abstract reflective	Natural sciences
Soft pure	Concrete reflective	Humanities and social sciences
Hard applied	Abstract active	Science-based professions
Soft applied	Concrete active	Social professions

The dimensions of hard–soft and pure–applied (Biglan, 1973b), or concrete–abstract and reflective–active (Kolb, 1981), together with the four-cluster model based on them, are useful tools for understanding the implications and origins of the possible disciplinary differences found in this study, as these groups have been found to have some defining characteristics. Hard pure disciplines have been seen as strongly paradigmatic, meaning that these disciplines have a strong inner consensus about the content and method used inside the discipline (Biglan, 1973a), with a general aim for universal and simplified knowledge (Becher, 1994). Hard applied disciplines differ from the hard pure ones specifically with their aims (Nevgi, Lindblom.Ylänne, & Levander, 2012), as they are concerned with pragmatic solutions that can better the physical environment (Becher, 1994). Soft pure disciplines generally have a more reiterative approach to knowledge and is interested in particulars, while soft applied disciplines that derive their theories from soft pure sciences, are largely concerned with improvements of professional practices (Becher, 1994). Suggestions on further disciplinary differences have

been found, for example, regarding students' approaches to learning (Parpala, Lindblom-Ylänne, Komulainen, Litmanen, & Hirsto, 2010), and teachers' approaches to teaching (Lindblom-Ylänne, Trigwell, Nevgi, & Ashwin, 2006), with students in hard sciences being more likely to use a surface approach to learning, while teachers being more teacher-focused compared to the more student-focused teaching in soft sciences.

As Becher (1994) discusses, differences between both, the disciplinary areas and the institutional organization play a role in the context of higher education (see also Ramsden, 1997). In this study, the faculties are examined as such, since they are already existing, discipline-based administrative entities with their own practices and cultures. This should not be overlooked especially when contemplating possible differences between the pure and applied disciplines, as the curriculums in University of Helsinki differ drastically between the pure, more general studies and the applied, profession-aimed ones with the latter having more school-like structure provided by the university. Thus, the cluster models of Biglan (1973b) and Kolb (1981) are used to merely position the faculties studied in the present study in the field of existing research to gain deeper understanding of the phenomena around disciplinary differences.

3.2 Academic Disciplines and Epistemic Beliefs

Previous research suggests that there may be some differences in students' epistemic beliefs in different academic disciplines, though no unanimous view has been attained as the results of the studies have been varied. Studies on disciplinary differences have had diverse approaches, as some researchers have experimented with disciplinary specific research tools (Hofer, 2000), while others have examined differences between hard and soft disciplines (Jehng, Johnson, & Anderson, 1993) or specific majors (Lonka & Lindblom-Ylänne, 1996). In Hofer's (2000) study on epistemic differences between science and psychology students, she found that students with a science major showed higher appreciation towards certain knowledge than the ones with a psychology major. Jehng et al. (1993) additionally suggested that students with majors in soft

sciences (social sciences, arts, humanities) are likely to see learning as iterative and subjective, and knowledge as uncertain. Lonka & Lindblom-Ylänne (1996) studied students in psychology and medicine, finding medicine students to hold more dualistic beliefs than psychology students that had overall more relativistic epistemic beliefs.

Meanwhile, signs of disciplinary differences regarding epistemic beliefs have raised questioning towards the developmental models, and valuing some beliefs higher than the others (Hofer, 2000). Hofer (2000) additionally suggested that in light of academic disciplines, some epistemic beliefs shouldn't be viewed directly as more advanced than others, as different disciplines have varying views that are likely to be shared among the professionals of the discipline as well. On the contrary, King & Kitchener (1994; 2004) as well as Schommer (1990) suggest that despite the discipline, more relativistic epistemic beliefs are connected to better understanding of complex problems and overall comprehension.

Furthermore, it has been suggested, that both general and domain specific epistemic beliefs exist simultaneously (Buehl & Alexander, 2005; Hofer; 2016; Lonka & Lindblom-Ylänne, 1996; Schommer & Walker, 1995). This means that, for example, a student can hold very relativistic epistemic beliefs overall, while thinking that certainty of knowledge is important in hard sciences. This kind of perspective does seem likely, as different disciplines have varied appreciations and cultures (Becher, 1994), while epistemic beliefs are seen as a part of an individual's developing mind, progressing especially in interactions of formal education (see Baxter Magolda, 1992; Entwistle & Peterson, 2004; Perry, 1970; Schommer & Walker, 1995). In other words, a student might overall have a tendency towards specific epistemic beliefs, but as their formal education continues in the university studies, the development of their epistemic beliefs continues also (see Lonka & Lindblom-Ylänne, 1996). Thus, it is possible that the students' epistemic beliefs somewhat conform with the ones generally appreciated in their discipline. However, more comprehensive research on epistemic beliefs regarding the possible disciplinary differences, disciplinary specific development, and the connections of them is still needed.

3.3 Academic achievement

When students are accepted to university, the university's goal is ultimately to offer quality education for a new generation of knowledgeable academics (University of Helsinki, 2020). In this light, research on academic achievement, and the processes and factors related to it can be both interesting and useful for education providers like universities. The framework and dimensions of academic achievement are discussed below in the context of the present study.

Study progress is calculated with acquired credits in a specific timeframe. The credit system used in Finland is based on European Credit Transfer and Accumulation System (ECTS) that is part of the Bologna Process aiming for more student-centered learning and easier mobility between European countries (European Commission, 2017). Most of Finnish University degrees are Master's Degrees (300 ECTS), and the estimated study time is 5 years (3 years for Bachelor's degree + 2 for Master's). Students are expected to earn 60 credits, or do 1,600 hours of studying in one school year, making the amount of work for one credit about 27 hours (Finlex, 2017). For the universities, supporting their students in meeting this expected study progress is not an insignificant goal, for Finnish universities get the base of their funding from the government, and the yearly amount of government funding is based on the university's success in engaging in research, and teaching the students. Success in teaching is evaluated by the number of students that have met the goal of 60 credits per year, and the number of graduated students. (Ministry of Culture and Education of Finland, 2017). Also for the Finnish students, there is a financial incentive for meeting expected study progress (see Korhonen & Mäkinen, 2012). Finland has a student benefit system that is created to ensure a stable income for those students who study full time (Raivola, Zechner, & Vehviläinen, 2000; Kansaneläkelaitos, 2015). The standard for qualifying for this student benefit is set by law, and for university students it means earning at least 5 credits per month or approximately 45 credits a year (Finlex, 2017). The 15 credits difference in what students are required to earn, and what a university needs students to earn in order to receive government funding are in conflict. As human beings, the

students are more likely to be interested in their own income than worrying about the university's funding, which might not push them to meet the 60-credit goal set in Bologna Process. Undoubtedly it would be pleasant to think that the universities want to teach well, and the students to learn eagerly just for the sake of it, but realistically the financial ties of the system can not be overlooked.

The other aspect of academic achievement in this study is study performance, measured with the Grade Point Average (GPA) of each students' overall grades, graded on the Bologna scale 1–5 (scale somewhat congruent with the American scale E–A (Heiskanen & Lonka, 2012)). Even though GPA doesn't have as direct of ties to the societal structures as the cumulative credits do, it helps us to gain perspectives of students' learning outcomes. Earlier studies have, for example, related higher GPA to students with meaning oriented, self-directed, and optimistic approach to studying (Heikkilä & Lonka, 2006; Heikkilä et al., 2012; Heikkilä, Niemivirta, Nieminen, & Lonka, 2011). Additionally, connections between study performance and epistemic beliefs have previously been shown, indicating less relativistic epistemic dimensions being positively linked to lower overall GPA (Schommer, 1993; Heikkilä et al., 2012). Epistemic beliefs have also been found to influence overall comprehension (Schommer, 1990), learning orientations (Entwistle & Peterson, 2004), and study engagement (Heiskanen & Lonka, 2012), likely impacting academic achievement through these factors (Hofer, 2000).

4 Present study

The aim of the present study is to examine the epistemic beliefs of first-year students of University of Helsinki, and to identify epistemic profiles occurring among these students. Also of interest is the presence of the identified epistemic profiles in the different academic disciplines in the University of Helsinki. Additionally, the profiles are compared to each other in terms of study progress and study performance during the first two years of the studies.

Overall, this study is interested in finding possible connections between epistemic beliefs, academic disciplines, and academic achievement. In the light of existing literature, distinct profiles are expected to be found (see Heikkilä et al., 2012; Heiskanen & Lonka, 2012; Lonka & Lindblom-Ylänne, 1996), as well as differences between the representation of them in the different faculties, the more reflective and relativistic profiles being more broadly represented in soft disciplines and the profiles appreciating practical and certain knowledge high being more likely in applied disciplines as well as hard sciences (see Hofer 2000; Jehgn, 1993; Lonka & Lindblom-Ylänne, 1996). Additionally, more relativistic epistemic beliefs are expected to be connected to higher academic achievement (Lonka & Lindblom-Ylänne, 1996; Schommer, 1993).

Research questions

1. What kind of epistemic profiles can be found within first year university students?

2. How does the representation of these identified epistemic profiles differ between academic disciplines?

3. How do the epistemic profiles differ from each other in regards to study progress and study performance?

5 Method

This study is part of a bigger longitudinal research project, funded by Suomen Akatemia (*Finland's Academy*), called Mind the Gap (2013 – 2016). The aim of Mind the Gap was to help develop Finnish schools to meet the goals of learning in today's world and it consists of multiple different themes around studying, technology, and well-being. The data for the project was collected from various locations within different age groups and levels of education. This study used quantitative data collected from university students with a questionnaire, and the analysis was performed using statistical methods.

5.1 Participants

The data used in this study was collected from first year university students in 2013 and 2014, mostly from students studying at the University of Helsinki. The data was attained mainly from large introductory courses in the beginning of university studies. Students answered the questionnaire voluntarily and were not compensated for participating in the study. The questionnaire was constructed by researchers of the Mind the Gap research project and data was collected by researchers themselves and research assistants working in the project at the time. The project consisted of seven themes with a total of 49 specific areas of interest. In this study, I use parts of the basic background information the students provided (ie. year of birth, gender, starting year of studies, their major) and 15 questions regarding conceptions of knowledge and learning. The original data given to be used in this study was already coded in SPSS-format and had n = 1206 subjects. In addition, data from University of Helsinki study register was used to provide information on student's study progress (total credits) and study performance (grades) after the first and second year of studying in the university.

Firstly, this study was restricted to be only about the students studying in the University of Helsinki and only the first-year students in years 2013 and 2014 were included. Secondly, some of the students didn't provide their major, give their permission for the use of the collected data in additional research needs, or

didn't give permission to use the given data linked together with other data sources (in this study, student records). Additionally, several students failed to provide their student ID-number, which was needed to retrieve data from the student register about the students' study progress and performance, and in some of the faculties the number of students taking part to the study was too low for statistical comparisons ($n < 9$), leading in excluding them from the study.

Finally, after the exclusions mentioned above, the total sample studied in this study ended up at 823, of which 556 (66.9 %) were women, 273 men (32.9 %), and 2 (.2 %) didn't specify their gender. Nearly half (47.2 %) of the students were 20 years old or younger, 39.3 % were 21 to 25-year-olds and 13.5 % 26 or older. Altogether 108 (13.0 %) participants had a previous degree in higher education, of which 37 (4.5 %) a previous master's degree. Some (21 participants) of 703 (87.0 %) participants who didn't report a previous higher education degree, however, mentioned previous higher education studies, which could mean they have done some previous studies without finishing a degree. Background information presented by the faculties showed in Table 2.

Table 2. Backgrounds of students studying in different faculties: age, gender, and the percentage of students who have previous higher education (Bachelor's or Master's) degree.

	Age (%)			Gender (%)		Previous studies (%)
	–20	**21–25**	**26–**	**Women**	**Men**	
Arts	57.1	35.7	7.1	85.7	14.3	16.7
Social Sciences	58.3	25.0	16.7	75.0	25.0	15.0
Science	63.9	24.1	12.0	35.5	64.5	5.1
Medicine	39.0	50.0	11.0	69.5	30.5	11.0
Law	38.3	48.9	12.8	70.0	30.0	19.8
Behavioral Sciences	37.9	46.4	15.7	86.1	13.9	14.9
Overall	**47.1**	**39.3**	**13.5**	**66.9**	**32.9**	**13.0**

5.2 Measures

Epistemic beliefs

The students' epistemic beliefs were measured with MED NORD, a measure developed by Lonka, Sharafi, Karlgren, Masiello, Nieminen, Birgegård, and Josephson (2008). The version of MED NORD used in this study consisted of 15 statements on learning and knowledge. Students rated all items using a six-point Likert-scale ranging from 1 (*completely disagree*) to 6 (*completely agree*). The tool measures five different dimensions of epistemic beliefs: *collaborative knowledge building, reflective learning, valuing metacognition, certain knowledge, and practical value.* The mentioned 15 statements represent five different dimensions of epistemic beliefs that were further computed into five composite variables representing these dimensions. The variables loaded to five factors just as expected, and the sum variables were created as presented in Table 3. Cronbach's alphas were calculated for the sum variables to check the reliability. Cronbach's alphas of each variable were above .70, which is often used as a limit for reliability of a composite variable (Metsämuuronen, 2011). The questionnaire used in the data collection was in Finnish and the statements presented in the table were translated from Finnish to English.

Academic Disciplines

The students provided their major in an open field in the questionnaire. These majors were coded into a categorical variable and then further classified and decoded into the faculties. Six of the possible nine Faculties were included in this study, for the remaining three didn't have enough participating students (see 5.1). Frequencies of the students in different faculties represented in this study are presented in Table 4.

Table 3. The composite variables used in the analysis, number of the variables used to compute it, an example of the statements they consist of, and the Cronbach's Alphas.

Composite Variable	Variables used (*n*)	Example of the statements used in the Composite Variable	Cronbach's α
Collaborative Knowledge Building	4	*"I think it is important that the teacher and the students are working together with the topics studied."*	.80
Reflective Learning	3	*"When we're dealing with new things on studies, I often think about my earlier related knowledge."*	.75
Valuing Metacognition	2	*"By learning your own ways of thinking, you can achieve much better goals."*	.78
Certain Knowledge	4	*"It is important that the correct answer to the problems can be ensured from the teacher."*	.77
Practical Value	2	*"The theory is useful only if it can be applied to practical life."*	.73

Table 4. The frequencies and proportions of students in different faculties as well as the percentage of the students studying for a specific profession in said faculty.

Faculty	*n*	Percent of all participants (%)	Students in the faculty studying for a profession (%)
Faculty of Behavioral Sciences	281	34.1	94.0
Faculty of Science	217	26.4	3.7
Faculty of Law	141	17.1	100.0
Faculty of Medicine	82	10.0	100.0
Faculty of Social Sciences	60	7.3	3.3
Faculty of Arts	42	5.1	0.0
Total	**823**	**100.0**	**60.2**

The majors used to determine the faculties of the students were also used to determine whether the students' studies were targeted for a specific profession (applied) or for a more general (pure) degree. The students were categorized according to model developed by Biglan (1973) and furthered by Becher (1994), presented in Table 5. Overall 60.2 % of the participating students studied for a specific profession. Differences between the faculties were noteworthy (see Table 4).

Table 5. Positions of the Faculties of University of Helsinki in the four-cluster model (Biglan, 1973b; Kolb, 1981).

	Hard / Abstract	**Soft / Concrete**
Pure / reflective	Faculty of Medicine	Faculty of Behavioral Sciences Faculty of Law
Applied / Active	Faculty of Science	Faculty of Arts Faculty of Social Sciences

Study Performance and Study Progress

Academic achievement in this study was defined as how well they proceed in their studies (*Study Progress*) and how are they performing in them (*Study Performance*). An additional data set containing study performance (grades) and study progress (credits) was retrieved from the student register of University of Helsinki. The measure used for Study Progress was the cumulative credits (ECTS) from the two first years of university studies. Study Performance was measured by calculating the grade point average (GPA) of all the completed classes. The majority of the classes were evaluated on the Bologna scale 1–5, though some were evaluated with statements like "good skills" or "passed" instead of a numeral grade. These statements were decoded into numeral grades

according to national guideline (Elsinen & Juurakko-Paavola, 2006), with “good skills” replaced with Bologna scale 4,5, and “passed” with 3.

5.3 Analysis

The analysis was conducted in three different steps to answer the three research questions. The program used to analyze the data was SPSS 24.0 (Statistical Package for the Social Sciences). A combination of person-oriented and variable-oriented approach was chosen to examine connections, first, between the epistemic dimensions themselves, and second, different variables in relation to the epistemic groupings (profiles) identified.

First, a TwoStep cluster analysis was performed to identify what kind of epistemic profiles the students form. The aim of cluster analysis is to find an existing structure in a sample, minimizing the within-group variation and maximizing the between-group variation (Chan, 2005). TwoStep Cluster Analysis identifies the clusters by first forming pre-clusters and then running hierarchical clustering methods. The strategies used to determine the number of clusters in this study were information criteria (BIC), visual inspection of the elbow plot, and theoretical meaningfulness of the solution. Therefore, cluster analysis is an exploratory technique, and it has been applied to partition multivariate data in diverse disciplines to support further analysis (Okazaki, 2006; Chan, 2005). One of the benefits of TwoStep cluster analysis is its ability to include both continuous and categorical variables in the same model (Chan, 2005). Second, crosstabs were used to study how these identified profiles are presented in different faculties, to examine the possible disciplinary differences. Crosstabs was chosen as it is a useful tool when interested in the relation of two categorical variables, which both the profiles and the faculties are. Chi-Square was calculated to reveal the possible significant differences. Finally, Multivariate Analysis of Covariance (MANCOVA) was performed to answer the question how the epistemic profiles differ in terms of Study Performance and Study Progress. MANCOVA was chosen for its ability to study the possible connections between the profiles and the Study Performance and Study Progress in one model, while having the faculty

as a covariate. Covariate was added to the analysis to statistically control the effect of the faculty, as it could overpower the main variable's effect (Spicer, 2005). Using MANCOVA instead of individual ANCOVAs can also be beneficial because MANCOVA is able to consider the correlations between different variables (Bray & Maxwell, 1985). Overall, taking a multivariate approach can be especially useful in studies in social sciences, where the measurement is not as exact as in natural sciences (Cole, Howard & Maxwell, 1981).

6 Results

6.1 Descriptive analyzes

Little's MCAR (Missing Completely at Random) was used to examine whether the missing values in the data set seems to have a pattern or to appear at random. MCAR test result was not significant (p = .946) for the epistemic sum variables, indicating the missing values appear at random (Cramer & Howitt, 2004). Percentages of missing values for each sum variable were fairly low (.6 – 1.1 %), the lowest (.6 %) in Practical Value and Valuing Metacognition, and the highest (1.1 %) being in Collaborative Knowledge Building. For the Study Progress and Study Performance, MCAR gives a significant result (p < .001), indicating a pattern, which is explained by the students who didn't accomplish any studies (cumulative credits being 0), didn't have a GPA to retrieve from the student records.

Normality of the sample was first explored through Kolmogorov-Smirnov's test, the initial reads (p < .005) seemed to suggest the sample not being normally distributed. Additionally, both skewness and kurtosis (see Table 6.) were more than double than standard error in most (except Certain knowledge for Skewness, and Valuing Metacognition and Practical Value for Kurtosis) of the composite variables (Appendix 3), which suggest them being significant (Cramer & Howitt, 2004). However, when the sample is large (n > 200), Kolmogorov-Smirnov's test cannot be trusted fully, because it invariably shows significant results for large samples (Reunamo, 2010). Examining the histograms comparing samples to normal curve showed that despite the slight skewness of the samples, they seem to follow normal curve fairly well (Appendices 1 & 2). Slight ceiling effect was noticed in collaborative knowledge building and in valuing metacognition. Presence of the ceiling effect should not be overseen, as neglecting can lead to faulty conclusion of no effect (Cramer & Howitt, 2004). Overall, skewness in larger samples in general is less harmful for the credibility of the results, but should still be recognized when interpreting the results and making further assumptions (Cramer & Howitt, 2004). It has been suggested, that with larger sample sizes

graphic methods should be used to analyze the normality of the sample (Metsämuuronen, 2011). Accordingly, based on the comparisons with normal curve (see histograms on appendices 1 & 2), and the large size of the sample, further analysis was decided to be performed with the assumption of normal distribution of the sample.

Table 6. Key figures for the main variables.

	n	Range	*M*	*SD*	Skewness	Kurtosis
Collaborative Knowledge Building	822	1.50 – 6.00	4.78	.80	-.748	.602
Reflective Learning	825	1.33 – 6.00	4.20	.95	-.245	-.496
Valuing Metacognition	826	1.50 – 6.00	4.85	.88	-.619	.072
Certain Knowledge	825	1.00 – 6.00	3.62	1.01	-.096	-.534
Practical Value	826	1.00 – 6.00	4.13	1.13	-.434	-.109
Cumulative Credits (ECTS)	831	0.00 – 267.00	106.25	40.67	-.503	1.042
Grade Point Average (GPA)	802	1.00 – 5.00	3.49	0.66	-.455	.627

Correlations between the sum variables representing the epistemic dimensions was examined, with Pearson correlation was analyzed, showing the strongest positive correlations between Collaborative Knowledge Building and Valuing Metacognition (r = .429), and Practical Value and Certain Knowledge (r = .296). Strongest negative correlation was detected between Reflective Learning and Certain Knowledge (r = -.204).

Correlation between the cumulative credits and the GPAs was also inspected with significant results (Pearson correlation, r = .34), additionally verifying the absence of collinearity for them with the correlation coefficient being below .90 (Tabachnick & Fidell, 2013).

Table 7. Pearson correlations between different epistemic dimensions in the whole sample.

	Collaborative knowledge building	Reflective learning	Valuing metacognition	Certain knowledge	Practical value
Collaborative knowledge building	1				
Reflective learning	.29**	1			
Valuing metacognition	.43**	.38**	1		
Certain knowledge	-.03	-.20**	-.04	1	
Practical value	.07**	-.14**	.05	.40**	1

** Correlation is significant at the .001 level

6.2 Three different epistemic profiles

The TwoStep cluster analysis was performed with standardized variables and using log-likelihood as the distance measure. First, the program was given the freedom to determine the number of clusters. The clustering criterion used was Schwarz's Bayesian Criterion (BIC). With an input of five variables (epistemic dimensions), two clusters were found with fairly good cohesion and separation, average silhouette being .3 and ratio of sizes 1.41. Closer examination of the BIC table, and visual interpretation of the graph drawn using the elbow technique (see appendix 4) supported either two- or three-cluster solution (BIC Change Ratios with 2 – 5 -cluster solutions were 1.000, .404, .185, and .175, respectively). Additionally, inspecting the theoretical meaningfulness of both two and three cluster solutions supported the three-cluster solution in relation to previous research. With three-cluster solution the silhouette stayed at .3 with the ratio size of 1.52, with BIC = 2301.27, BIC Change = -155.15, BIC Change Ratio = .404, and Ratio of Distance Measures = 1.610.

Two of the three clusters expressing the epistemic profiles found were similar in size (38.8 % and 35.6 %), while one was slightly smaller (25.6 %). Overall, the dimensions with the highest predictor importance were practical value and valuing metacognition (1.00) and the lowest collaborative knowledge building

(0.68). Valuing metacognition was the overall most highly scored dimension with mean at 4.85 (*SD* = .88) and certain knowledge the lowest with mean at 3.62 (*SD* = 1.01). Non-parametric Kruskal-Wallis test was used to ensure the differences in the epistemic dimensions between different profiles were statistically significant. The test showed significant results ($p < .001$) for differences between the different profiles for all the epistemic dimensions. Differences between the profiles presented in Figure 1 and Table 8.

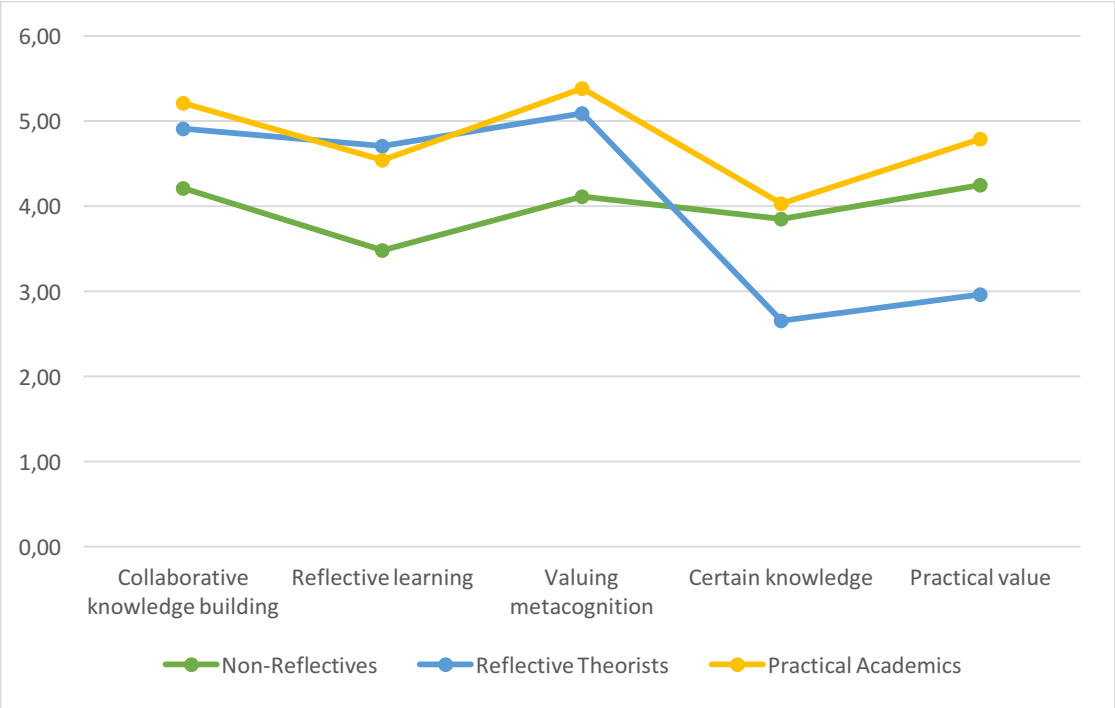

Figure 1. Means of the five epistemic dimensions in each of the identified profiles.

In the first profile (*n* = 285, 36.6 %) the students had the lowest appreciation towards Collaborative Knowledge Building, Reflective Learning, and Valuing Metacognition. Appreciation for Certain Knowledge was slightly higher than the overall mean, as was the appreciation for Practical Value. The second profile (*n* = 205, 25.6 %) stood out with the highest mean in Reflective learning, and the lowest means in Certain Knowledge and Practical Value (both with means below 3.0) of all the profiles. They also had slightly higher than mean scores in Valuing Metacognition and Collaborative Knowledge Building. The third and the largest profile (*n* = 311, 38.8 %) had the highest scores of all the profiles in all the other epistemic dimensions, except in Reflective Learning, which they still appreciated

higher than the overall mean. The highest means in the profile they had in Valuing Metacognition, Collaborative Knowledge Building, and Practical Value. At last, the profiles were named *Non-Reflective Students, Reflective Theorists,* and *Practical Academics,* respectively. More in depth discussion in the light of the existing studies on these epistemic profiles identified continues in Chapter 7.

Table 8. Appearance of the epistemic dimensions in the profiles.

	Profiles			Overall	
	Non-Reflectives ***n*** **= 285** **36.6 %**	**Reflective Theorists** ***n*** **=205** **25.6 %**	**Practical Academics** ***n*** **= 311** **38.8 %**		
	M **(*SD*)**	***M*** **(*SD*)**	***M*** **(*SD*)**	***M*** **(*SD*)**	**Predictor importance**
Collaborative knowledge building	4.21 (.73)	4.91 (.73)	5.21 (.55)	4.78 (.80)	0.68
Reflective learning	3.48 (.79)	4.71 (.76)	4.54 (.77)	4.20 (.95)	0.75
Valuing metacognition	4.11 (.77)	5.09 (.72)	5.38 (.53)	4.85 (.88)	1.00
Certain knowledge	3.85 (.83)	2.65 (.74)	4.03 (.89)	3.62 (1.01)	0.73
Practical value	4.25 (.94)	2.96 (.88)	4.79 (0.78)	4.13 (1.13)	1.00

6.3 Disciplinary differences between the profiles

The second interest of the present study was to examine disciplinary differences through how the epistemic profiles are represented inside of the different faculties. This was examined using Crosstabs. Calculated chi-square suggested significant differences between the profiles in some of the faculties (χ^2 (10, N = 793) = 54.5, p < .001). Figure 2 portrays the percentages of different profiles inside the faculties and Table 9 shows the numbers of students by faculty and epistemic profile, also pointing out the profiles with significantly different presence compared to the other profiles inside of the same faculty.

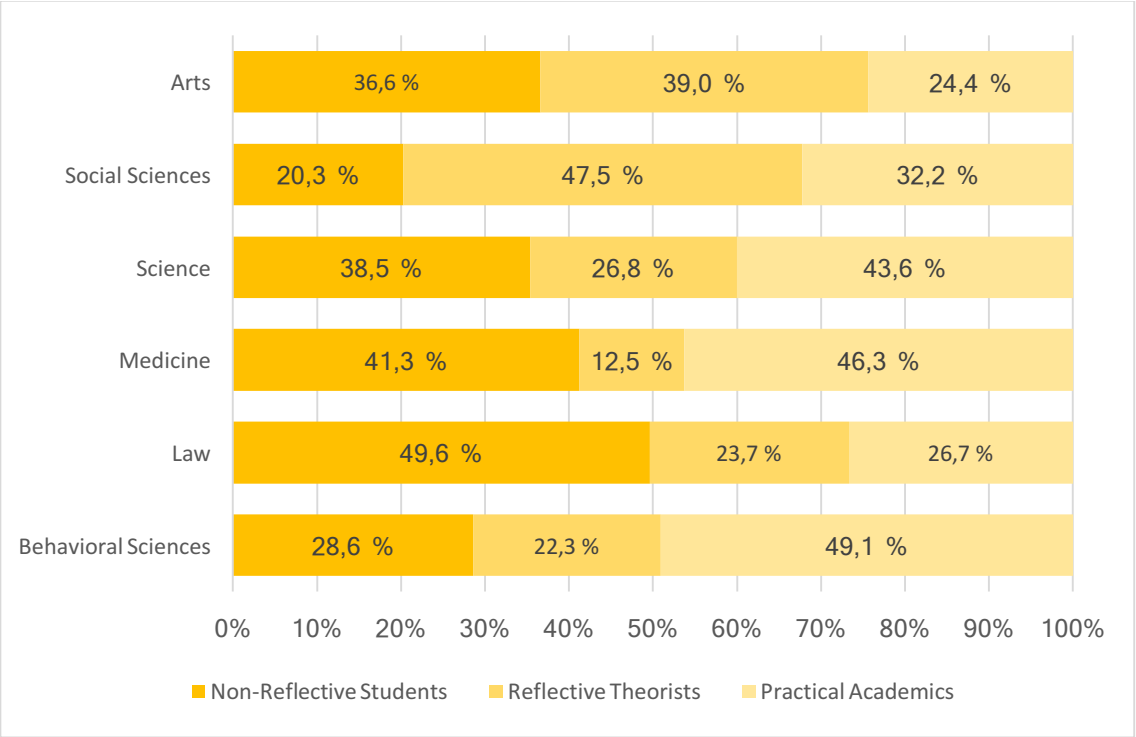

Figure 2. The proportions of epistemic profiles in each faculty.

Results show significantly high frequencies of Non-Reflective Students in the Faculty of Law (49.6 %), Reflective Theorists in the Faculty of Social Sciences (47.5 %), and Practical Academics in Behavioral Sciences (49.1 %). Students of the Faculty of Medicine showed significantly low frequency of Reflective Theorists, and were nearly equally divided between Non-Reflective Students and Practical Academics (41.3 % and 46.3 %, respectively). In the Faculty of Sciences, no significant differences were found between the different profiles, though altogether nearly 75 % of the students represented profiles with higher appreciations for Certain Knowledge and Practical Value (Non-Reflective Students and Practical Academics). In the Faculty of Arts, only the representation of Reflective Theorists and Practical Academics differed significantly, with Reflective Theorists being more frequent. Although, due to the small number of students from the Faculty of Arts in this study, the numeral differences between the students in the different profiles, though statistically significant, are very small (see Table 9).

Table 9. Numbers of students in each profile by the faculty. Marked are the groups that significantly differ from the others in the same faculty.

	Profile			
Faculty	**Non-Reflective Students**	**Reflective Theorists**	**Practical Academics**	**Total**
Arts	15	16_a	10_a	41
Social Sciences	12	28*	19	59
Medicine	33	10*	37	80
Law	67*	32	36	135
Sciences	79	55	71	205
Behavioral Sciences	78	61	134*	273
Total	100 %	100 %	100 %	100 %
n	284	202	307	793

* Significantly differs from the others on the same row at the .05 level.

$_a$ Significantly differ from each other at the .05 level.

Considering some of the faculties having strongly pure, and others strongly applied disciplines, it seems that Reflective Theorists are more broadly represented in the faculties with pure disciplines (significantly in the Faculty of Social Sciences) while simultaneously being less frequent in the faculties with majority of the students studying an applied discipline, significantly so in the Faculty of Medicine. Additionally, the two profiles accentuating Practical Knowledge were significantly high in some of the applied disciplines: Non-Reflective Students in the Faculty of Law, and Practical Academics in the Faculty of Behavioral Sciences.

6.4 Epistemic profiles and academic achievement

Final research question was interested how these epistemic profiles differ from each other in Study Performance and Study Progress, which was researched with Multivariate Analysis of Covariance (MANCOVA). In addition to testing assumptions for Analysis of Variance, a preliminary MANCOVA with custom terms was performed to affirm that all the additional assumptions for MANCOVA were met before conducting the final analyses (Appendix 5).

Box's test of Equality of Covariance Matrices was significant ($p < .001$), hence Pillai's trace was used to determine the significance in further readings as it is thought to be more robust in readings where the equality of variances might not apply (Metsämuuronen, 2011). Results of MANCOVA initially suggested a significant result for the profiles, with $p = .001$ (F (4, 1520) = 4.499) and the covariate (faculties) at $p < .001$. Although, Levene's test results directed to only accept the results for Study Performance (F (2, 761) = 2.699; $p > .05$), as study progress read a significant result ($p = .001$) indicating its error variances not being equal, thus not meeting the assumption for the test regarding Study Progress. Accordingly, stricter measure for the significance level was used ($p < .01$) when reading the results.

The results for MANCOVA are presented in Table 10. Although the differences in the means of Study Progress of the different profiles were not significant, some differences did exist. For Study Performance, significant results between the epistemic profiles were present, though the effect size was very small at $\eta^2 = .021$, explaining only 2.1 % of the variance in the Study Performance. Faculties showed a significant main effect ($F = 4, 829$, $df = 1$) at p = .000 for the covariate. One-way ANOVA with post-hoc tests (Bonferroni) were conducted for Study Performance to examine the specific differences between the profiles. Significant differences were found between Non-Reflective Students and Reflective Theorists ($p < .001$) and Reflective Theorists and Practical Academics (p = .008), while the difference between Non-Reflective Theorists and Practical Academics was marginally significant.

Table 10. Means, standard deviations and MANCOVA results the epistemic profiles in Study Progress and Study Progress.

	Profile					
	Non-Reflective Students (*n* = 271)	**Reflective Theorists (*n* = 189)**	**Practical Academics (*n* = 304)**	***F* (2, 760)**	***p***	***η²***
	M (SD)	M (SD)	M (SD)			
Study Progress*, ECTS	106.90 (35.74)	115.05 (40.90)	111.05 (43.85)	3.779	=.023	.010
Study Performance, GPA	3.39[a] (.70)	3.65[†] (.69)	3.50[a †] (.57)	8.031	<.001	.021

[a] Means between these groups do not differ significantly at the $p < .05$ level.

*Levene's test for Equality of Error Variances suggests the assumption for equal variances between groups is not met with this variable; $p < 0.05$

[†] Marginally significant at $p = .057$

7 Discussion

The aim of this study was to explore first-year university students and their epistemic beliefs with a person-oriented approach by examining what kind of epistemic profiles can be found among them. Additionally, the aim was to further examine how the representation of the identified profiles differ in different academic disciplines, and their possible relation to academic achievement. In this chapter, I will, after summarizing the results, discuss them and their limitations in the light of previous research, and finally draw some conclusions.

7.1 Summary of the results

Three epistemic profiles were identified: *Non-reflective Students*, *Reflective Theorists*, and *Practical Academics*. The first profile, Non-Reflective Students, valued Collaborative Knowledge Building, Reflective Learning, and Metacognition lower than the other profiles. The second profile, Reflective Theorists, had the highest value in Reflective Learning, while having considerably low values in Certain knowledge and Practical value. The third profile, Practical Academics, had high values in all dimensions, the most in Collaborative Knowledge Building, Valuing Metacognition and Practical Value.

These three profiles showed significantly different frequencies in the different faculties examined, as well as differing emphasis on the students majoring in pure and applied disciplines. Reflective Theorists were significantly less frequent than the other two profiles in the Faculty of Medicine with 12.5 %, while being significantly more frequent in the Faculty of Social Sciences (47.5 %). Nearly half (49.1 %) of the students in the Faculty of Behavioral Sciences belonged to the profile of Practical Academics alone, similarly to the students in the Faculty of Law representing the Non-Reflective Students (49.6 %). In the Faculties of Science none of the profiles had significantly different frequency than the others, and the differences in the Faculty of Arts were somewhat small, despite Reflective Theorists being significantly more frequent than the Practical Academics. Additionally, Reflective Theorists were represented more frequently in Faculties

with majors in pure disciplines, while Non-Reflective Students and Practical academics were more present in faculties with applied majors.

Finally, Study Performance showed a significant relation to the epistemic profiles, when the effect of the faculties was controlled. Reflective Theorists had significantly higher GPA than the two other profiles. No significant relation was found with Study Progress and the profiles. Furthermore, the profiles explained only 2.1 % of the differences in Study Performance.

7.2 Discussion

Three rather similar in size epistemic profiles were found, with clearly distinguishable similarities with earlier person-oriented studies on epistemic beliefs (Heikkilä et al., 2012; Heiskanen & Lonka, 2012; Lonka & Lindblom-Ylänne, 1996). The first epistemic profile (35.6 %), *Non-Reflective Students,* differed from the others by scoring the lowest in Collaborative Knowledge Building, Reflective Learning and Valuing Metacognition. They also scored highly in Certain Knowledge and Practical Value in relation to the overall mean, and the other epistemic dimensions in the profile. In their person-oriented study on teacher students Heikkilä et al. (2012) identified a profile (‘*Non-Regulative Students*’) valuing Certain Knowledge and Practical Value similarly to the results of the present study. In the profile they (Heikkilä et al., 2012) found, Certain Knowledge and Practical Value were also connected to lack of self-regulation, high task-avoidance, and high numbers of reported stress and exhaustion. Another similar profile called ‘*cook-book students’* (Heiskanen & Lonka, 2012) found in engineering students, was also connected to low optimism and weaker study engagement than the profiles valuing reflective learning higher. Additionally, the more dualistic epistemic beliefs, including high appreciation for Certain Knowledge, have been found to be linked to the need for external regulation and intake-focused ways of acquiring knowledge (Lonka & Lindblom-Ylänne, 1996).

Reflective Theorists (25.6 %) valued Certain Knowledge and Practical Value the lowest while having slightly higher than mean values in Collaborative Knowledge Building and Reflective Learning, with the value of Reflective Learning being the highest of all the profiles. A similar epistemic profile was found by Heiskanen and Lonka (2012), showing rather clearly that the profile appreciated the more relativistic epistemic beliefs highly, while having a low appreciation for the ones categorized as more dualistic. Additionally, valuing Certain Knowledge and Practical Value lowly has previously been positively connected to deep understanding, critical evaluation, and academic achievement (Heiskanen & Lonka, 2012), as well as constructivity (Lonka & Lindblom-Ylänne, 1996), and comprehension (Schommer, 1993).

The profile of *Practical Academics* (38.8 %) scored Collaborative Knowledge Building, Valuing Metacognition and Practical Value especially high, while also showing consistently high values in all the remaining epistemic dimensions studied. Identifying this profile together with the Non-Reflective Students accentuates the pliant relation of Practical Knowledge with other epistemic dimensions. Previously, there have been findings that Practical Knowledge has been related to otherwise more relativistic epistemic beliefs, especially in the context of academic professions (Lonka & Lindblom-Ylänne, 1996). Schön (1983) has also identified a model of professional problem solving, called reflection-in-action, emphasizing the valuable combination of valuing reflectivity of knowledge in the practical setting of practicing a profession. Additionally, this profile shows similarities to the profile of reflective professionals that Heiskanen & Lonka (2012) identified in their study to teacher students, which was found to be positively linked to, for example, high optimism and low task-avoidance.

Although identifying three profiles between distinct epistemic differences is noteworthy itself, discussing them in relation to the further aspects of this study, differences between the academic disciplines and academic achievement, offers possibilities for more intriguing findings. As stated before, some significant differences were found in the representation of the profiles in different faculties. Firstly, Reflective Theorists were significantly more frequent in the Faculty of Social Sciences and less frequent in the Faculty of Medicine than the other

profiles, while Practical Academics were significantly more frequent in the Faculty of Behavioral Sciences, and Non-Reflective Students in the Faculty of Law. Lastly, a significant difference between the Reflective Theorists and Practical Academics in the Faculty Arts was found, although the number of students participating was quite small, making the result quite trivial.

Most of the results found were largely as hypothesized, and in line with the previous studies (Hofer, 2000; Jehng et al., 1993; King & Kitchener, 1994; Lonka & Lindblom-Ylänne, 1996). The students of the Faculty of Behavioral Sciences and the Faculty of Law being significantly largely present in different epistemic profiles is theoretically somewhat unexpected, as they both can be categorized to soft applied disciplines (Biglan, 1973a; Kolb, 1980; Becher; 1994). Additionally, visual assessment of the results pointed out a clearly distinguishable observation: the rest of the students in the Faculty of Medicine were virtually split in half between Non-Reflective Students and Practical Academics, and nearly half of the students in the Faculty of Science represented Practical Academics. The strongly divided presence of the students of the Faculty of Medicine raised some questions, and is discussed in more detail below.

In regards to the results for this second research question, it should not be forgotten that the present sample consisted only of first-year university students. This means, that the possible effect of the differing cultures and practices between the different faculties can't be expected to have influenced the students' epistemic beliefs due to the short time spent studying in the faculty. Thus, the differences found between the representation of the different epistemic beliefs in this study, may have more to do with what kind of students choose to study a major within a certain faculty and how the faculty operates their student intake, than with the general appreciations and practices of the discipline.

Considering the vast differences between the faculties in the number of students studying for a specific profession, it seems that Reflective Theorists were in general more likely to appear in the faculties with students majoring in pure soft disciplines (Social Sciences, Arts), while being less frequent in the faculties with most of the students majoring in applied disciplines, aiming for a specific

profession (Medicine, Behavioral Sciences, Law). Reflective Theorists' low values in more dualistic epistemic beliefs and high appreciation for the more relativistic ones seems natural in pure soft sciences, like social sciences and humanities, as the nature of the problems solved in these disciplines is complex in a way that they often can't be solved with a high degree of certainty (see King & Kitchener, 1994). Additionally, Becher (1994) emphasizes that these disciplines hold value in interpreting per se, and reaching a comprehensive understanding of the studied phenomena. Thus, as these pure soft disciplines don't necessarily hold a lot of value and interest in the possible practical solutions of the knowledge acquired, students already holding epistemic beliefs appreciating uncertainty and reflectivity might feel naturally more drawn to these disciplines that share their appreciations.

On the contrary, both Non-Reflective Students and Practical Academics seem to be more broadly represented in the faculties with a lot of students majoring in applied disciplines, that distinctly require practical knowledge along with the extensive academic understanding. Even though both profiles appreciate Certain Knowledge and Practical Value highly, Practical Academics value the rest of the epistemic dimensions even higher, differentiating the two profiles from each other. Of the students majoring in applied disciplines, the students of the Faculty of Medicine were divided almost equally between these two profiles, while the students of the Faculty of Law were broadly represented in Non-Reflective Students and students of the Faculty of Behavioral Sciences in Practical Academics.

It is interesting that while both Faculties of Law and Behavioral Sciences are clearly in the realm of soft applied disciplines and educate their students for specific professions (Lawyer, Judge, or Notary in Law, and Elementary School Teacher, Pre-School Teacher, or Psychologist in Behavioral Sciences), notable differences can be found between the social context of these two groups of professions, starting with, for example, the expected level of income after graduation. Having the students of the Faculty of Medicine (to be Medical Doctors or Dentists) pairing up nearly equally with the students of the Faculty of Law, and

the students of the Faculty of Behavioral Sciences allows us to further discuss the epistemic differences inside of a discipline.

Previously, similar to the present study, Lonka and Lindblom-Ylänne (1996) found medical students showing a strong professional study orientation, meaning that only information that was directly applicable to real-life was appreciated. Though, in their study (Lonka & Lindblom-Ylänne, 1996), the professional study orientation was additionally connected to lower interest in academic theoretical questions and less relativistic epistemic beliefs, suggesting a closer relationship to the Non-Reflective Students, than the Practical Academics. Another relevant result concerning the epistemic differences inside of an applied discipline was one by Ferry & Ross-Gordon (1998) using Schön's (1983) model of reflection-in-action that examines the link of reflectivity and practicality in the context of academic professions. They (Ferry & Ross-Gordon, 1998) found distinct differences in the ways of problem-solving between reflective and non-reflective professionals inside one discipline, with the reflective professionals seeing problem-solving as an iterative learning process, while the non-reflective professionals distanced themselves from the process and treated it merely as a scientific procedure. Non-reflective Students and Practical Academics differ from each other specifically in regards to appreciation of the more reflective and relativistic beliefs, additionally suggesting further reflectivity-related differences between these two profiles. Thus, it seems possible that these students majoring in applied disciplines could have other similar, possibly motive-related, differences towards their future profession.

Furthermore, finding that the students of the Faculty of Medicine being so distinctly divided in two different epistemic beliefs supports the earlier results suggesting that though some disciplinary tendencies might exist, the differences inside of the same discipline can be equally notable (see Schommer & Walker, 1995). Hofer (2000) has criticized valuing some epistemic beliefs as more sophisticated or advanced, since some of the more dualistic epistemic beliefs might also be highly appreciated in specific disciplines. Even though the results of the present study somewhat support Hofer's (2000) argument, and share similarities with other previous studies (see Becher, 1994; Hofer, 2000; Jehng et

al., 1993; Lonka & Lindblom-Ylänne, 1996), it seems important to differentiate the epistemic beliefs that an individual holds as a part of their means of making meaning of the world, and the general appreciations, even requirements, of different academic disciplines. As, for example, Biglan (1973a; 1973b), Kolb (1980), and Becher (1994) have suggested, disciplinary differences on the institution level may be fairly clear and definable. Meanwhile, considering the diversity of the perspectives in this present study, suggests that there is a lot we don't know about the disciplinary differences of epistemic beliefs.

Finally, this study was interested in how these epistemic profiles differ in regards to Academic Achievement. No significant differences were detected in Study Progress. In Study Performance, Reflective Theorists had significantly higher GPA than the students in the two other profiles (3.65), while Practical Academics (3.50) had only marginally significantly higher GPA than the Non-Reflective Students (3.39). In other words, significant differences in regards to Study Performance between the different profiles were found in this study. This suggests, similar to previous studies, that a higher appreciation for more relativistic, especially reflective, epistemic beliefs are somewhat positively connected to better academic achievement (Buehl & Alexander, 2005; Schommer, 1993; Heikkilä et al., 2012). Although, more reflection is needed in terms of this result.

Firstly, as the small effect size of the epistemic profiles in regards to the study performance suggests that though some connections can be found, epistemic beliefs are by no means the only factor linked to academic achievement. Previous studies have found epistemic beliefs to be linked to factors including approaches to studying (Entwistle & Peterson, 2004) and well-being (Heikkilä et al., 2012), that have additionally been connected to study performance (see Entwistle & Peterson, 2004; Lonka et al., 2008). Furthermore, it has been suggested, that epistemic beliefs are in a reciprocal relationship with, for example, approaches to studying, meaning that as epistemic beliefs are thought to develop through educational experiences, they are then thought to influence the ways of studying (Entwistle & Peterson, 2004; King & Kitchener, 1994). This well demonstrates the complexity of the connections in the field of epistemic studies, as the related

factors can affect each other in constant interaction. Though, including academic achievement in this present study, there have been fairly consistent results on appreciation on reflectivity being related to overall positive factors in the university context.

Secondly, it should be noted that in studies on epistemic beliefs, the aspect of academic achievement is often researched merely by comparing the GPA's of the students studied (Heiskanen & Lonka, 2012; Schommer, 1993), as it was in the present study, too. It can, and should, be questioned whether GPA is the most suitable measure for academic achievement, as differences between the grading systems can vary largely even between the same faculty, let alone different universities. In addition to varying grading standards, the ways of measuring students' learning also vary greatly. Some disciplines generally, as well as individual teachers, rely more on multiple choice type of testing, as others test the students' understanding with group assignments, essays, or portfolios. As the varied ways of evaluation regarding individual courses can't, and frankly shouldn't, be removed, it would be interesting to see studies on epistemic beliefs in relation to academic achievement, where academic achievement was measured by something more comprehensive than a mere GPA, for example, the grade of a thesis (Bachelor's or Master's).

Lastly, although there were no significant differences regarding the Study Progress in this study, some aspects of it are worth of discussing. The first interesting notion is that when examining the Study Progress through statistical means in this study, none of the profiles met the goal of 60 credits a year, the requirement for the university's government funding. The second interesting observation is that the profiles with the majority of the students majoring in applied disciplines that generally have more structure provided by the university, completed fewer studies. This is interesting, as it could be thought that the more support and structure the students get from the university, the easier it would be for them to progress in their studies. In general, not as much research is done on study progress as is done on study performance, though these observations suggest that there could be a place for that.

7.3 Limitations of the study

The limitations, the validity, of a study should always be carefully considered while making further assumptions and generalizations of the results (Metsämuuronen, 2011; Ronkainen, Pehkonen, Lindblom-Ylänne, & Paavilainen, 2011). Generally, the overall validity of a study can be evaluated through reliability, and various aspects of validity (Metsämuuronen, 2011; Shadish, Cook, & Campbell, 2002). In this chapter I will discuss the limitations of the present study through reliability, construct validity, internal validity, and external validity of the study, as well as review the possible shortcomings of the analysis.

Reliability was assessed to review the quality of the tools and measurements used (Metsämuuronen, 2011). The measurement scale used to measure the students' epistemic beliefs was a version of MED NORD -tool developed by Lonka et al. (2008). The internal consistency of the tool was examined with Cronbach's Alphas, which were higher than .70 for all the sum variables used in the study. Additionally, parts of the tool have been used in previous studies with varied samples, and the results of the present study had similarities with them (Lonka et al., 2008; Heikkilä et al., 2012). Careful preliminary analysis was performed to check that the assumptions of each test are met. Visual examination of the sample pointed out some (< 20) outliers in the data, and the boxplot readings showed that only one of the outliers was extreme (value of 267.00 ECTS in cumulative credits). As all the detected outliers were examined qualitatively, and since no clear abnormalities in the variable input or background information were detected (see Metsämuuronen, 2011), the outliers were not deleted from the sample.

Construct validity was evaluated to assess whether the measures are measuring what was intended (Metsämuuronen, 2011). Operationalizing the researched phenomena, on one hand, is an essential part of empirical research, but on the other hand, forces us to strongly simplify complex realities (see Ronkainen, 2011; Shadish et al., 2002). The tool, MED NORD (Lonka et al., 2008), has been successfully used in other studies, and improved along the way. The correlations

between the different dimensions reiterated the results of the previous studies (Heikkilä et al., 2012; Heiskanen & Lonka, 2012; Lonka & Lindblom-Ylänne, 1996). Additionally, here are two factors that should not be forgotten, but that are also in the core of the present study: firstly, students from varied disciplines could understand the epistemic statements differently (see Kuhn, 1962), and secondly, the students are first-year students, who could have challenges with understanding the statements as intended due to their short academic experience (see Schommer et al. 1992; Schommer, 1993). Though, the same measure (MED NORD, Lonka et al. 2008) has been used to assess the epistemic dimensions outside of university education, suggesting that careful consideration of the wording had been done in developing a measure that is easily understood. Overall, profound work was done to choose and discuss the chosen terminology used in the study critically.

Internal validity is concerned with the truthfulness and logic of the connections found (see Metsämuuronen, 2011; Shadish et al., 2002; Ronkainen et al., 2011). Firstly, the approach and methods were carefully discussed with the research community, and chosen to answer the research questions in consideration of the limits of the sample. Also, it can be questioned whether GPA is the best measurement for Academic Achievement. As in many other research cases (Shadish et al., 2002), also in this one, GPA was used for its accessibility. In addition, different faculties and teachers could have largely varying standards for grades, which makes directly comparing them with each other somewhat questionable. The small effect size (2.1 %) of the connection between the Epistemic Profiles and Study Performance indicate that even though there can be a statistically significant connection found, there are many other factors explaining this connection too. Additionally, some of the epistemic dimensions in the MED NORD -tool (Lonka et al., 2008) were measured with only two statements (Valuing Metacognition and Practical Value), which could raise the risk of possible misunderstandings impacting the data (Reunamo, 2010). Again, the questionnaire was overall rather extensive, and lengthening the individual sections could have compromised the sample size (see Metsämuuronen, 2011) as the overall length would have grown. While the questionnaire having a broad overall target group might have helped Lonka et al. (2008) to create an easily

understandable measure, the statements together with the Likert-scale possibly contributed to some (Collaborative Knowledge Building and Valuing Metacognition) of the variables having ceiling effect. University education has been suggested to be connected to an overall higher appreciation for more relativistic epistemic beliefs (Schommer, 1993), indicating that any wording of the statements measuring relativistic epistemic beliefs on a Likert-scale would result in a slight ceiling effect in a sample of university students.

External validity was assessed to examine how well the results of the study can be generalized (Metsämuuronen, 2011; Shadish et al., 2002). Shadish et al. (2002) remind about a common challenge of over-generalizing the results of a local study. The present study was strongly local, and even though the sample size of this study can be considered large, it was also quite homogenous. University students in general tend to have similar family backgrounds (Nevala, 2000), and are a select part of the society. Finland overall, and thus higher education also, lacks variety in the students' ethnic and cultural backgrounds, meaning that the students in this study were mainly Caucasian individuals born in Finland. However, Finland has a specific societal structure to support the students, which can allow the socio-economic background of the students (not researched in this study) to be more varietal than in countries with high-cost university education. An additional challenge with the sample was an unequal presentation of students from different faculties. For example, over a third of the students participating in the study were from the Faculty of Behavioral Sciences alone. The differences in the number of participants between different faculties was not because some faculties have substantially more students than the others. More likely it is due to the varying possibilities to visit large introductory courses in different faculties to collect the data. Additionally, there is no data on how many questionnaires were handed out in total to evaluate the number of people who didn't finish the questionnaire. The differences in the group sizes between the faculties were considered when constructing the experimental design to minimize the effect of varied group sizes. One strength of this sample is that university students are largely researched in regards to epistemic beliefs, so this study together with the existing ones can help build a more comprehensive understanding of the early university studies and the role of the epistemic beliefs

in them. Additionally, the sample is acknowledged to be strongly local and thorough descriptive information was provided, to help anyone reading the study and its results in assessing how relatable it is to their needs (see Shadish et al., 2002).

Shadish et al. (2002) state validity strictly as a “property of inferences” (p. 34), meaning that no method is valid or invalid, as validity is merely about using suitable methods for the situation, and drawing the valid conclusions from the results. Accordingly, a critical look at the utilized methods from the perspective of their suitability for the purposes of this study was taken. Firstly, a proper sorting (described in the chapter 5.1) of the sample was performed prior to any analyses, as well as thorough preliminary analyses to ensure the chosen methods being suitable for the sample at hand. The overall aim was to provide a detailed walk-through of the sample, results and research decisions made along the way to ensure repeatability, as well as room for the readers’ additional interpretations. It is important to note that as this study was cross-sectional, no conclusions of causality can be made. Overall, using a person-oriented approach to research the connections of the epistemic profiles with academic disciplines and achievement offered a more tangible perspective on the epistemic beliefs of the university students than a variable-oriented view possibly could have offered. Both, the profiles being congruent with ones identified in previous studies (Heikkilä et al., 2012; Heiskanen & Lonka, 2012; Lonka & Lindblom-Ylänne, 1996), and there being further differences found between the profiles in terms of academic disciplines and academic achievement, additionally support the validity of the cluster solution. Though a method combining person-oriented and variable-oriented approaches can cause challenges in drawing conclusions from the diverse results (Bergman et al., 2003), the results were largely supported by the previous studies. Furthermore, choosing the combined approach allowed us to see some rarely researched observations, as well as concretely see the complexity of the phenomena researched.

7.4 Conclusions

Overall, the results of this study can be read from a few perspectives: on one hand, there seem to be some generally more highly valued epistemic beliefs among the university students (Collaborative Knowledge Building, Reflective Knowledge, Valuing Metacognition), and on the other hand, some existing structures, the profiles, with varied appreciations in epistemic beliefs can be found. Additionally, while some clear disciplinary differences exist especially regarding the appreciation of Practical Value between pure and applied disciplines, simultaneously, diversity among the profiles represented exist in all the examined faculties. And lastly, while high appreciation of relativistic epistemic beliefs and low appreciation of dualistic epistemic beliefs seem to be connected to better study performance also in this study, the effect size suggests that there are other factors that are connected to it even stronger. Therefore, as this study has furthered our understanding on the meaning of epistemic beliefs in the context of university students, it has also raised new questions.

Regarding the epistemic profiles in relation to academic disciplines and study performance, four things seem increasingly clear among the university students: a) the more relativistic and reflective epistemic profiles seem to have overall higher and more consistent appreciation, than the more dualistic ones, even among the first-year students, b) despite the overall appreciation of the more relativistic epistemic beliefs, there seem to be some existing structures connecting the epistemic beliefs in specific, and repeated, ways with each other, c) while being not exactly unambiguous, some overall direction on disciplinary differences can be found, especially between the appreciation of practical knowledge between pure and applied disciplines, and d) higher appreciation for reflective learning seems to be somewhat positively linked with better study performance.

Furthermore, awareness of these kinds of epistemic structures existing, can be useful for universities and faculties in planning how to support their students in

being successful in their studies at large. On the practical level, the university administration, professors, and teachers can, and should, take students' epistemic beliefs into account when planning the best possible practices for their students. Next, I will draw some possible further conclusions and suggestions on how to take what we know about the university students' epistemic beliefs into account.

First, since the more relativistic epistemic beliefs seem to be overall higher in the university students already in the beginning of the studies, the reciprocal nature of the relationships between epistemic beliefs and, for example, learning orientations and other study practices (Entwistle & Peterson, 2004) could be consciously utilized. For example, activating the students critical and relative ways of thinking from the beginning of the studies, by using self-regulatory strategies instead of giving direct instructions, could support the students' progress towards more constructivistic understanding of knowledge (Vermunt, 1998), which again can lead to activating study situations.

Second, being aware of the different epistemic profiles existing effectively everywhere in the university, while the proportions could vary between the disciplines, can encourage the teachers and professors to adjust their teaching to the group at hand. Despite Entwistle & Ramsden (1983) talking about the diversity in the students' learning styles, their advice to university educators is at least somewhat applicable towards diverse epistemic beliefs, taking into consideration the close relation between epistemic beliefs and learning. They (Entwistle & Ramsden, 1983) encourage teachers to leave their dogmatic points of view, and acknowledge and appreciate diverse methods and practices in their class. As epistemic beliefs are also thought to be contextual in nature (Entwistle, 2007), it seems especially important that the teacher, while stimulating the students towards more reflective epistemic beliefs through pedagogical decisions, does not expect the epistemic beliefs of the students to align just because they share a discipline.

Third, while epistemic diversity should be recognized in the university studies, the identified overall directions of epistemic differences between the different

disciplines, could be utilized in, for example, the faculties further tailoring their student intake strategies. Currently in Finland, a large portion of the universities' student intake strategies focus on the students' previous academic performance, and the score of the possible, usually substance-focused, entrance exam. Utilizing the available epistemic understanding in planning practices for student intake could additionally help the faculties in choosing students that are suitable for their major, thus possibly setting the students up for success even before their university career begins.

Fourth, as higher appreciation for reflective learning seems to be linked to academic achievement, supporting students in using strategies that are positively linked with reflective learning, could, eventually, be beneficial for both the students and the university. Though, as discussed before, there are many other known and unknown aspects that have been linked to academic achievement in addition to reflective learning. However, reflective learning and other more relativistic epistemic beliefs have been found to be connected to a multitude of generally positive factors regarding learning, for example, critical thinking (King & Kitchener, 1994) and study engagement (Heiskanen & Lonka, 2012). As Schommer and Walker (1995) note, epistemic beliefs progress especially in the classroom interactions, thus it is not insignificant what kind of epistemic beliefs the teachers and professors reproduce in their classrooms actions.

As every study written, this one raised more questions than it gave answers to. Due to the quantitative nature of the present study, it lacked the more concrete and detailed examples of individual students experiences and beliefs on epistemic beliefs in the university context. While there is a long tradition of qualitative studies in the field of epistemic studies, further qualitative analysis of profiles found similar to this study seems to be absent. Additionally, more in depth studies are needed to examine the relationships of epistemic beliefs inside of the same disciplines, as the results of the existing studies have still a lot of ambiguity around the phenomena. These studies could also benefit from a more comprehensive approach, including cognitive and motivational aspects of learning (Heikkilä et al., 2012). The Mind the Gap –data used in this study also measured factors, such as, exhaustion and lack of interest that could be further

researched in relation to epistemic profiles. Lastly, it would be refreshing to see studies on epistemic beliefs and academic achievement using something other than GPA as the measure, as it might not measure the aspects we'd like think are academic achievement.

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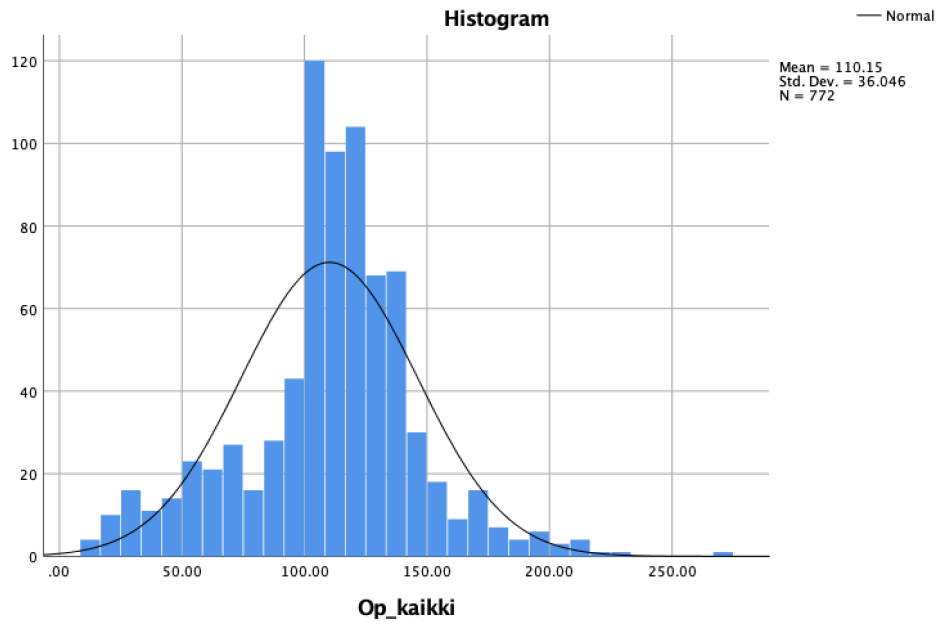
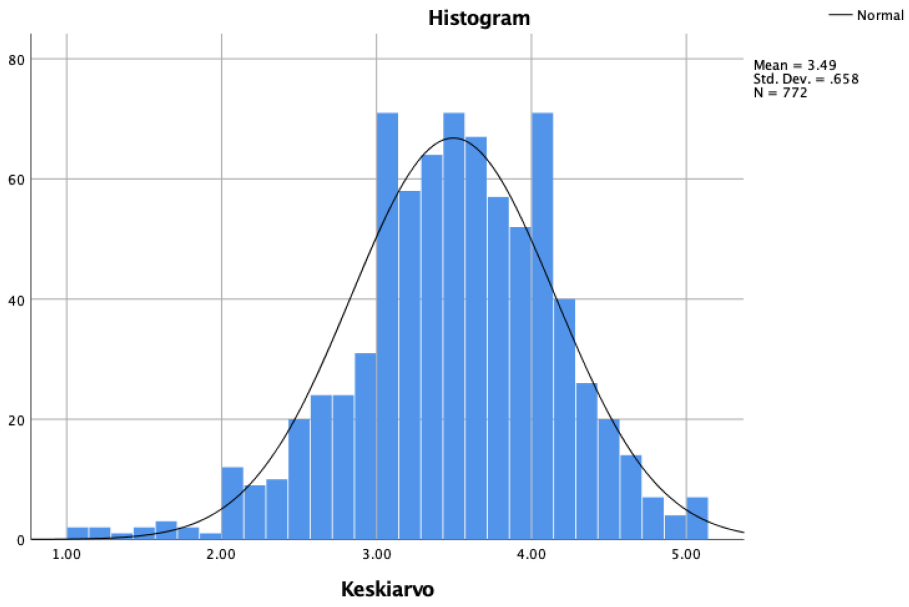
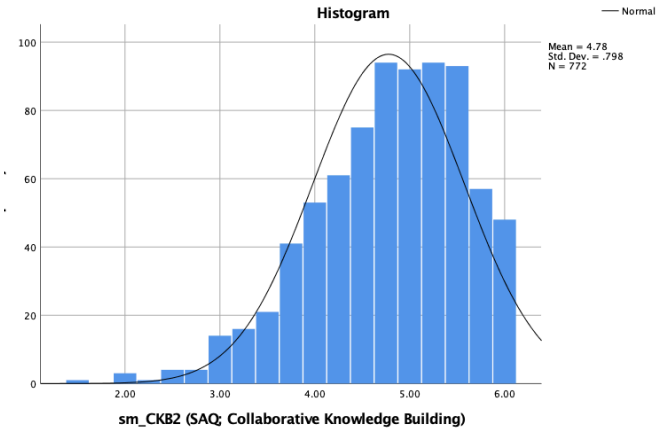
9 Appendix

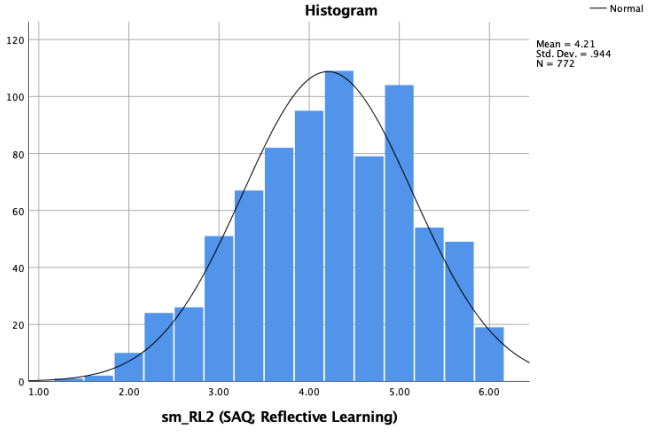
Appendix 1. Histograms of the normality for the study progress and study success.

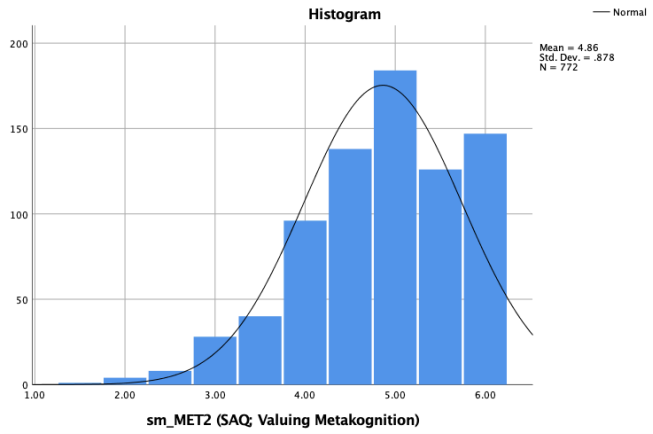


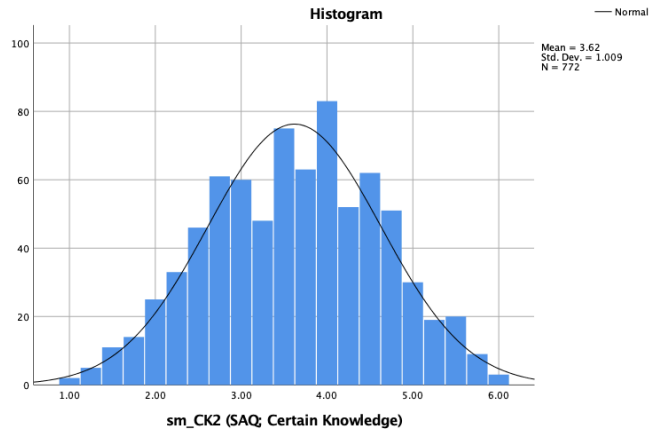


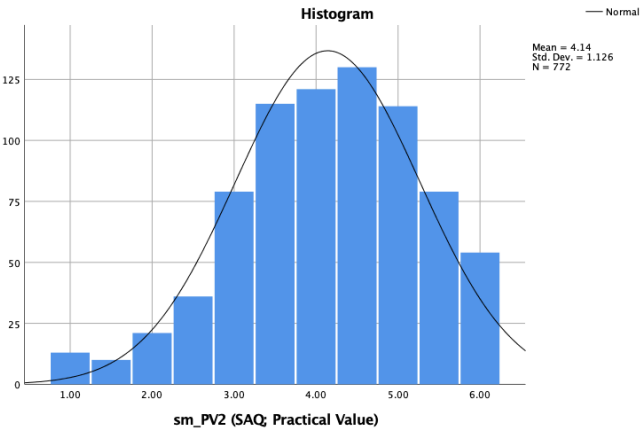
Appendix 2. Histograms of normality for the composite variables representing the epistemic beliefs.











Appendix 3. Table of kurtosis, skewness and the standard errors of them.

		Op_kaikki	Keskiarvo	sm_CKB2 (SAQ; Collaborative Knowledge Building)	sm_RL2 (SAQ; Reflective Learning)	sm_MET2 (SAQ; Valuing Metakognitio n)	sm_CK2 (SAQ; Certain Knowledge)	sm_PV2 (SAQ; Practical Value)
N	Valid	831	802	822	825	826	825	826
	Missing	0	29	9	6	5	6	5
Mean		106.2501	3.4892	4.7765	4.2028	4.8517	3.6164	4.1259
Std. Deviation		40.67321	.65595	.80099	.94585	.88014	1.01144	1.12918
Skewness		-.503	-.455	-.748	-.245	-.619	-.096	-.434
Std. Error of Skewness		.085	.086	.085	.085	.085	.085	.085
Kurtosis		1.042	.627	.602	-.496	.072	-.534	-.109
Std. Error of Kurtosis		.169	.172	.170	.170	.170	.170	.170
Minimum		.00	1.00	1.50	1.33	1.50	1.00	1.00
Maximum		267.00	5.00	6.00	6.00	6.00	6.00	6.00
Percentiles	25	92.0000	3.0909	4.2500	3.6667	4.5000	2.7500	3.5000
	50	112.0000	3.5152	4.7500	4.3333	5.0000	3.7500	4.0000
	75	128.0000	3.9529	5.5000	5.0000	5.5000	4.3750	5.0000

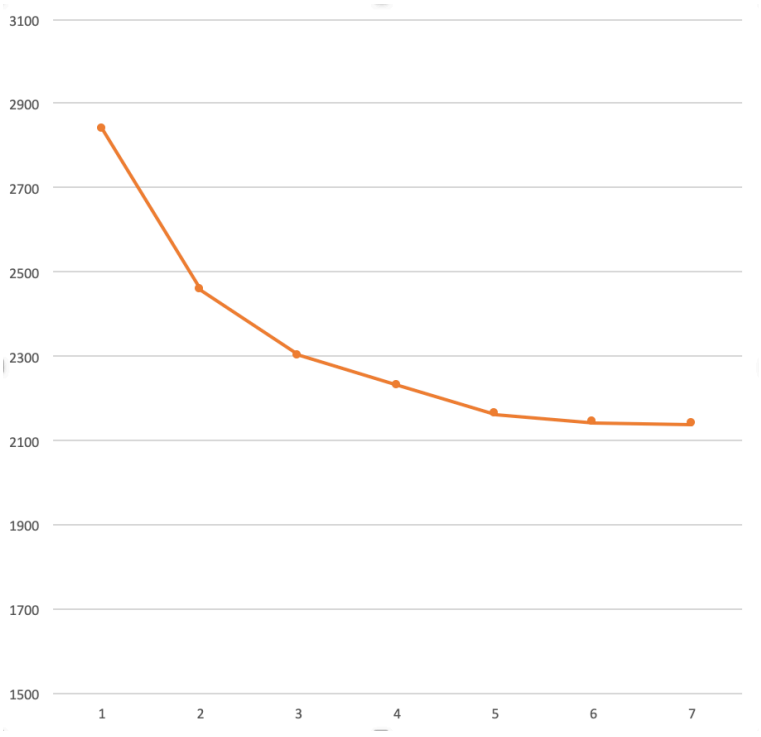
Appendix 4. BIC measures for TwoStep analysis. The graph shows the change of the BIC value when the number of the clusters change, with y-axis being the value of BIC and x-axis being the number of clusters.

Number of Clusters	Schwarz's Bayesian Criterion (BIC)	BIC Change[a]	Ratio of BIC Changes[b]	Ratio of Distance Measures[c]
1	2840.412			
2	2456.425	-383.987	1.000	2.031
3	2301.271	-155.154	.404	1.610
4	2230.191	-71.080	.185	1.028
5	2162.924	-67.268	.175	1.550
6	2143.236	-19.688	.051	1.203
7	2138.179	-5.057	.013	1.040
8	2135.895	-2.284	.006	1.255
9	2147.656	11.761	-.031	1.003
10	2159.558	11.902	-.031	1.168
11	2179.363	19.806	-.052	1.029
12	2200.502	21.138	-.055	1.134
13	2227.038	26.536	-.069	1.142
14	2258.584	31.547	-.082	1.091
15	2293.081	34.497	-.090	1.018

a. The changes are from the previous number of clusters in the table.

b. The ratios of changes are relative to the change for the two cluster solution.

c. The ratios of distance measures are based on the current number of clusters against the previous number of clusters.



Appendix 5. Evaluating meeting the assumptions for MANCOVA through preliminary analysis.

Box's Test of Equality of Covariance Matrices[a]

Box's M	28.416
F	4.717
df1	6
df2	6379586.98
Sig.	.000

Tests the null hypothesis that the observed covariance matrices of the dependent variables are equal across groups.

Multivariate Tests[a]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.908	3717.994[b]	2.000	757.000	.000	.908
	Wilks' Lambda	.092	3717.994[b]	2.000	757.000	.000	.908
	Hotelling's Trace	9.823	3717.994[b]	2.000	757.000	.000	.908
	Roy's Largest Root	9.823	3717.994[b]	2.000	757.000	.000	.908
Profiles	Pillai's Trace	.013	2.512	4.000	1516.000	.040	.007
	Wilks' Lambda	.987	2.514[b]	4.000	1514.000	.040	.007
	Hotelling's Trace	.013	2.515	4.000	1512.000	.040	.007
	Roy's Largest Root	.012	4.420[c]	2.000	758.000	.012	.012
tiedekunta	Pillai's Trace	.040	15.583[b]	2.000	757.000	.000	.040
	Wilks' Lambda	.960	15.583[b]	2.000	757.000	.000	.040
	Hotelling's Trace	.041	15.583[b]	2.000	757.000	.000	.040
	Roy's Largest Root	.041	15.583[b]	2.000	757.000	.000	.040
Profiles * tiedekunta	Pillai's Trace	.009	1.697	4.000	1516.000	.148	.004
	Wilks' Lambda	.991	1.696[b]	4.000	1514.000	[illegible]	.004
	Hotelling's Trace	.009	1.696	4.000	1512.000	.148	.004
	Roy's Largest Root	.008	2.845[c]	2.000	758.000	.059	.007

a. Design: Intercept + Profiles + tiedekunta + Profiles * tiedekunta

b. Exact statistic

c. The statistic is an upper bound on F that yields a lower bound on the significance level.

Tests of Between-Subjects Effects

Source	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	Op_kaikki	34831.155[a]	5	6966.231	5.595	.000	.036
	Keskiarvo	10.449[b]	5	2.090	4.973	.000	.032
Intercept	Op_kaikki	3382632.59	1	3382632.59	2716.678	.000	.782
	Keskiarvo	2864.484	1	2864.484	6816.060	.000	.900
Profiles	Op_kaikki	3846.156	2	1923.078	1.544	.214	.004
	Keskiarvo	3.633	2	1.816	4.322	.014	.011
tiedekunta	Op_kaikki	20184.807	1	20184.807	16.211	.000	.021
	Keskiarvo	2.108	1	2.108	5.015	[illegible]	.007
Profiles * tiedekunta	Op_kaikki	6791.029	2	3395.515	2.727	.066	.007
	Keskiarvo	1.049	2	.525	1.248	.288	.003
Error	Op_kaikki	943812.689	758	1245.135			
	Keskiarvo	318.553	758	.420			
Total	Op_kaikki	10318836.7	764				
	Keskiarvo	9674.142	764				
Corrected Total	Op_kaikki	978643.845	763				
	Keskiarvo	329.002	763				

a. R Squared = .036 (Adjusted R Squared = .029)

b. R Squared = .032 (Adjusted R Squared = .025)